INVESTIGATION OF ZINC, MAGNESIUM, AND ALUMINUM AS ETCHING SURFACES

PROBLEM IN LIEU OF THESIS

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By

John E. Stark, Jr., B. S.
Denton, Texas

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For the purposes of clarification, the letter "a" denotes zinc, "b" denotes aluminum, and "c" denotes magnesium.

CHAPTER I

INTRODUCTION

The introduction to printmaking in most universities and colleges directs students to learn the basic techniques of intaglio using zinc. This continues throughout one's academic career, with little emphasis placed on experimentation with other metals. During my undergraduate and graduate studies I etched with zinc. I had wanted to use aluminum and magnesium in order to explore the similar and dissimilar qualities of the three.

A search for information failed to produce much documentation on the use of aluminum and magnesium in the intaglio process. Therefore, it was necessary to investigate and document the similarities and dissimilarities of zinc, aluminum, and magnesium while using the various intaglio tools on each plate surface, the etching procedures, and the printing processes.

The first phase consisted of a zinc, a magnesium, and an aluminum plate with an edition of ten test pattern impressions from each plate. The second phase employed the same metals and consisted of an edition of ten imagery impressions from each metal. The imagery was used to illustrate various tools and techniques used in the intaglio process. The etching table (length of time in the acid bath), the effectiveness of various techniques used on respective metals and the problems encountered during the inking and printing of each metal surface were specific concerns which would be encountered.

A journal was kept throughout the experiment to record observations which were both personal in content and dealing with technical aspects of the investigation. Color slides were taken to provide a record of this work and these slides appear in the appendix of this paper.

CHAPTER II

METHOD OF PROCEDURES AND OBSERVATIONS

Zinc is commercially retailed for the purpose of etching, therefore no extra preparation was necessary.

Magnesium is commercially retailed for photo etching and it was necessary to sand this surface to remove a photo emulsion. The sanding prevented a clear, shiny surface, but with a soft cloth and putz pomade the surface was rubbed to produce a smooth and unscratched surface.

The aluminum plate surface was badly scratched and dull due to its being stored in a scrap metal pile. It was scraped, burnished, and putz pomade was applied by cloth. Steel wool was used to even the surface, then sanded with a fine grade sandpaper and steel wooled again. All this was done until most dullness and scratches were eliminated. Edges on all three plates were then beveled to prevent cutting the printing papers and the felt blankets used between the roller and the bed of the press.

Liquid asphaltum was applied to the surface to be etched while each plate was heated. Heating allowed for an even distribution of the ground. Once properly grounded and allowed to bake several minutes, the plates were removed from the hot plate, air cooled, and dried. They were then ready to receive the first application of technique.

Each of the plates in the first phase was identical in visual layout which can be seen by the illustration on the following page. Each section was assigned a different process using tools consistent with that specific technique. Similar areas were marked and etched simultaneously, but often with varying lengths of etching times.

Line (A) is a basic element of design and intaglio. Consequently, it was used for the first section. Each line was exposed to the acid until a specified time period was completed. The plate was taken from the acid bath, rinsed with water to remove acid residue, then placed on the hot plate where that completed portion of line had ground brushed over it. After drying this ground, the acid bath was repeated until the next time period and portion of line was completed. Again the plate was removed from the acid, rinsed in water, and covered by ground. On all plates and in most sections, this procedure was followed.

The purpose of etching each line for a particular length of time was to achieve a varying depth in relation to time in the acid bath. The less time in, the more shallow the bite. Conversely, the longer time in the acid, the deeper the bite.

Crosshatch (B) was obtained with the steel etching needle. Each plate was treated to show the effectiveness of a group of

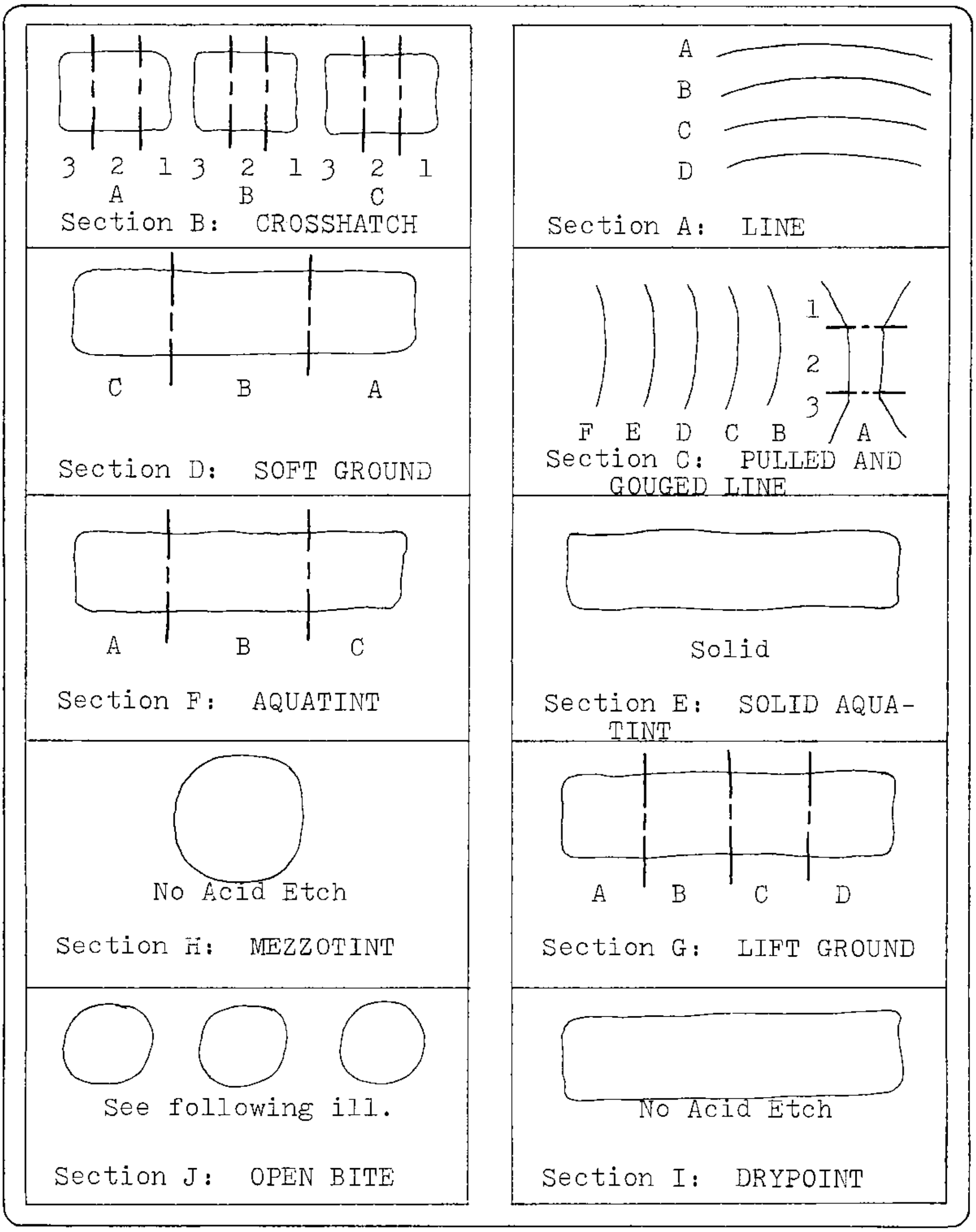


Fig. 1--Illustration of plate layout I

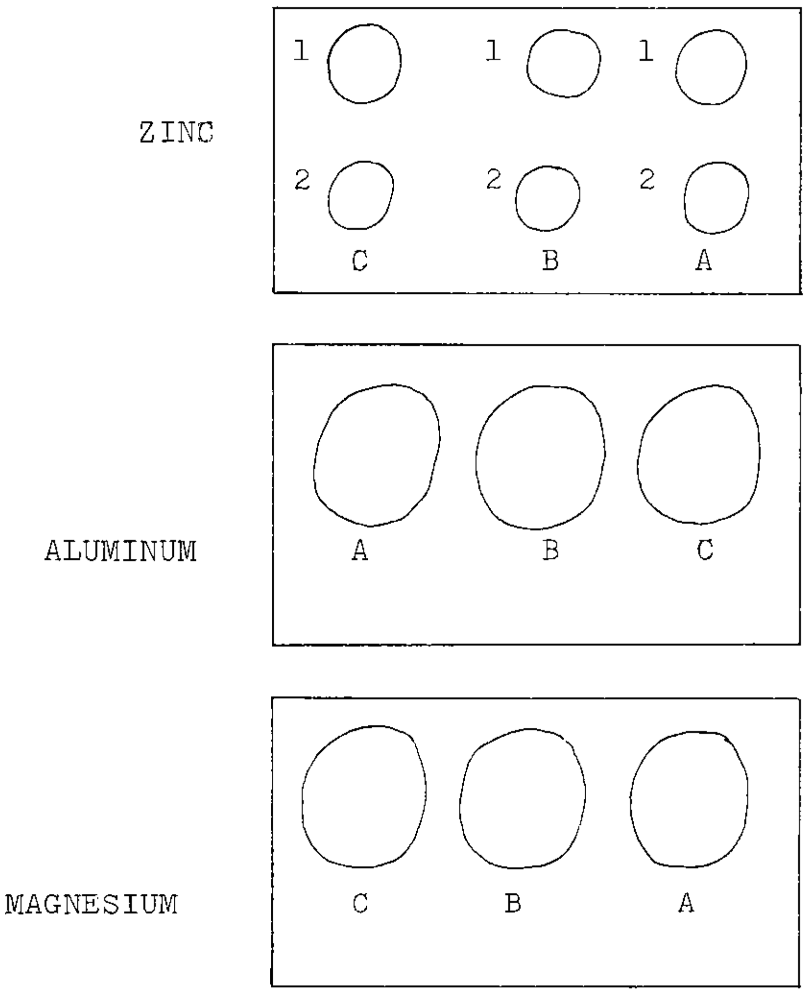


Fig. 2--Illustration of plate layout II

TABLE I

ETCHING TIME TABLE

Section		Time of Etch in Minutes		
		Zinc	Aluminum	Magnesium
A Line (Needle)	A	2	6	2
	B	6	9	6
	C	15	12	10
	D	20	20	10
B Crosshatch	A1	2	6	2
	A2	6	9	6
	A3	15	12	16
	B1	2	6	2
	B2	6	9	6
	B3	15	12	16
	C1	2	6	2
	C2	6	9	6
	C3	15	12	16
C Line (Scraper)	F	25	25	16
	E	20	25	16
	D	15	12	6
	C	6	9	6
	B	2	6	2
	A1	15	6	16
	A2	6	9	6

TABLE I--Continued

Section		Time of Etch in Minutes		
		Zinc	Aluminum	Magnesium
	A3	2	12	2
D Soft Ground	A	5	25	4
	B	12	12	6
	C	25	5	12
E Aquatint		17	23	7
F Aquatint	A	15 sec.	18	7
	B	1	13	3
	C	5	3	1
G Lift Ground	A	5	10	2
	B	10	6	4
	C	15	4	6
	D	20	2	8
H Mezzotint		No Acid	No Acid	No Acid
I Drypoint		No Acid	No Acid	No Acid
J Acid Tinting	A1	3	5	5
	A2	6		
	B1	3	5	5
	B2	6		
	C1	3	5	5
	C2	6		

lines marked and bitten in 1) a controlled and widely spaced group of lines, 2) lines at closer proximity to each other, and 3) quickly marked lines intersecting in an uncontrolled manner. It was my purpose in this section to investigate line etch effectiveness when using hatching to produce a value area.

A coarse prominent line (C) can be made through a long acid bite, but can also be made using a wide pointed tool. Using an intaglio scraper tip, five lines were marked onto the plate using a pulling stroke, and two lines utilizing forward gouges. A wider point such as this leaves a jagged line and the gouged line is wide as well as having a slight burr.

Soft ground (D) was applied within an area that was masked off with masking tape. A thin film of wax was applied with a roller over the exposed plate. A piece of brown wrapping paper was crumpled and placed over this film, and a sheet of waxed paper was crumpled and placed over this film, and a sheet of waxed paper placed over all this. It was then passed through the press at the normal plate pressure. When passed through the press, the most prominent wrinkles were pressed into the soft film, exposing the plate. It was these areas that were etched. Care must be taken to note whether metal is exposed after this procedure is completed. If not, the area will not etch properly.

Aquatint (E and F) was applied in an area defined by masking tape. The exposed area was cleaned with alcohol and placed inside an aquatint box. After the powdered rosin settles upon the plate surface, the plate is removed and placed on the hot plate. Each small particle of rosin melts and adheres to the surface. Once cooled, the plate is placed into the acid and is bitten around the melted drops. This texture is so fine that an even value is produced. One may control the value by the time period of the etch. Graininess can be adjusted by the amount and coarseness of the rosin laid on the surface.

Section E was left open in the etch for a longer period of time in order to produce a darker value. Section six was divided into three parts in relation to time in etch. Controlling the value of aquatint was important and this demonstrates the differences in value relative to times in etch. Lift ground was applied to the exposed metal surface by brush and allowed to dry before being covered by a thin film of a fifty-fifty percentage mixture of asphaltum and turpentine. To implement the processing of this section and control the lift of the ground, the metal plates were placed under hot, slowly streaming water. The ground began disintegrating and lifting away due to its water soluble base. The plate then was processed normally.

Mezzotint (H) is known for its resultant rich, velvety appearance. Rocking a mezzotint rocker repeatedly over the same area from different directions left a texture similar to that of aquatint. No acid bite was required.

A linear design (I) was marked onto the plate with an etching needle. A burr was raised by the needles being forecfully pulled across the metal surface. This holds ink as well as the cut furrows. Known for the tendency of the burr to become flattened with repeated printing, this was a good test for the softer metals in use during the investigation. This technique, as with mezzotint, required no acid bite.

Acid (J) was applied in various strengths with an eye dropper onto an exposed area of metal. With the completion of the zinc place, three areas containing these drops were eliminated, leaving three. It was felt that the remaining three would suffice in demonstrating the technique effectively.

Utilizing these ten techniques and the various tools required, desirable and undesirable results were observed. Each metal exhibited a unique and individual capacity for textures and reactions to techniques employed.

Observations of the Three Plates, First Phase

Line (A) used on the zinc was strong, as usual. The faint, lightly etched lines were sensitive and reliable elements. The lines etched in the least amount of time lost ink during printing due to their shallowness. On all surfaces when etched longer, the lines became deeper, hence blacker and often slightly wider. Zinc maintained a jagged edge when etched for more than six minutes. Neither aluminum nor magnesium had this characteristic, which was admirable. The magnesium line, regardless of time in etch, remained clean, its edges well defined, not jagged. It never became coarse as did the zinc and aluminum. On aluminum the acid produced a clean, strong line, but the longer etch made it heavier and black.

The basic purpose of this technique (B) utilizing line was in evidence on the zinc and aluminum surface. These lines fused together due to their close proximity, but also the longer acid bite contributed to this fusion. The individual line quality was identical to the previous sections. Magnesium lines, as a mass, remained sensitive and delicate when the other two surfaces became visually harsh, in relation to the longer etch. The zinc, during the uncontrolled part three began to lose its line definition. In other words, the individual lines began to fuse, forming wide and dark areas. This technique is very valuable for surface delineation within imagery and depth could be achieved easily with any of the metal surfaces. Value is possible with control of line placement. The placement which controls the fusing of lines somewhat, can prevent the harshness or coarseness evident on the zinc or aluminum.

Again line (C) is basic to this section, utilizing a wide pointed tool for marking. Two methods of marking were used and they were 1) gouging the line in parts A1, A2, A3, and 2) pulling the tool in B through F. In observing each surface there was little difference other than the individual characteristics of each line respective to each metal. The lines were wide, coarse and black. Magnesium was visually stronger due to its soft brittle nature. Its line edges remain clean cut. There were very small differences between etching times. The small width of the line was instrumental to this result as the acid would bite deeper instead of deep and wide.

As a softer metal, the aluminum plate (D) produced a blotchy appearance and very slight value differences in the area of the least etch. The soft ground area of least etching time on the zinc shows a creditable value range. Ridges from the pressed paper produced a reverse line, but generally the area is flat. Likewise, magnesium showed a weak gray portion, devoid of hard value differences. As the time in etch increased, so did value with magnesium. The texture is visually pleasing, but the zinc surface also produced some pleasant value changes, giving the appearance of dimension, through graininess similar to those in aquatint. Although the aluminum surface held its markings, it was not as long lasting as zinc and magnesium.

With a longer etch there was more contrast. Aluminum still did not show strong possibilities compared to zinc and magnesium, but it was very interesting to note the texture. As is usual in aluminum, a graininess comes through when printed to aide in the formation of small subtle shapes within the area. This offers an entirely new visual dimension for use. Magnesium remains very strong as only the contrast increases. White or reverse line combines with value to produce a rich texture and enhances its spatial quality.

To achieve a rich dark area within a composition is possible here with a very long etching time (E). The zinc surface produced that rich, dark area, leaving a solid desirable result. Magnesium also produced this result, only visually softer. A continuous etch on the aluminum surface resulted in an evenly textured grainy surface. It was etched for twenty-three minutes total imersion. Depth here is very prominent; a light feeling pervades the area.

As was expected, the characteristics of the aluminum aquatint were extremely grainy and gray (F). Zinc produced a light grainy surface also. A subtle and smooth surface was in evidence on magnesium.

A slightly longer etch gave the zinc a rather nice value, a desirable area, as compared to the first etch. A good quality aquatint came about on the aluminum and a dramatic increase in value was evident on magnesium, yet retained the softness the metal has.

The longer etched area was darker and again very rich on the zinc surface but a longer etch does not make much difference in areas on magnesium. Aluminum was about the same--grainy, but darker. As can be seen on all three surfaces, the high range of value differences with such short periods of etch can be a valuable process, and can be used quite extensively.

Shorter etches (G) did not result in sharp clear areas, but each metal retained its individuality. Aluminum was etched for several minutes, but the resultant area could barely be seen. Magnesium held some value, defined by small pits and the shapes formed by the brittle metal interacting with the acid. Zinc had little more than a weak light area. Even though areas like the above may be weak, they would serve well within a composition. As the etching time increased, zinc began to show valleys that deepen and shapes are defined. Slight value differences are evident whereas the aluminum is still relatively weak. Magnesium, however, had a strong, high contrast, a sharp, clear, visual area. Value and shape share in importance.

Lengthier etching times leave only slight differences on the zinc surface. The definition of areas exposed by the lift process is heightened only by darker, more deeply etched valleys, which hold more ink. Loss of value inside these areas result in a coarse, harsh appearance. Magnesium continues to grow towards a higher contrast relative to etching times, but its visual aspects remain and grow stronger. Once more, they are clear and sharp. The aluminum, after ten minutes, contains only subtle value differences and could be put to use well. Characteristics of each metal are retained, but the magnesium has produced a most rewarding result.

No etch (H) was used in this section yet a quality not unlike aquatint was achieved, appearing to have been etched. Magnesium, zinc, and aluminum were all close in resultant markings. Magnesium has the rich velvety texture which was also evident in the other two metals. In keeping with each individual characteristic, aluminum was grainy, yet retained the black depth common in its dark areas. Zinc achieved the same end and even though at first glance, it appears as an aquatint, it is much richer and visually reminiscent of velvet. The process is so different in technique yet achieves almost identical results as aquatint. Zinc continues to echo its hardness.

Once more, an etch (I) was not required here. Magnesium is consistent in that the line is soft, but the burrs along the lines' edges aid in this result. Depth is substantial with crosshatching. The line on the zinc surface appears as if it were etched, its quality is the same. As shown, line can be thin and delicate or heavy. The individual line retained its solidity alone and as a mass, was strengthened. Dimension is strong on the aluminum surface as the soft metal eludes to its softness. All three metals are equally strong with this technique.

Throughout this section, the various strengths of acids (J) on each metal left only small subtle indications that it had been reacting to the surface. Acid needs some form of tecture to bite around, whether it is powdered rosin or a lift ground. Using a four to one mixture of nitric acid on both the zinc and magnesium resulted in a slight grayish area. The zinc contained a second, longer etched area of the same strength acid, but there was little difference and similar results were produced when drops of eight to one of the same solution was applied. The magnesium surface was extremely weak. Nitric acid, applied full strength, left a very sensitive spot, with some value of a graying appearance. The magnesium left an indication only that something had indeed occured on the surface.

The aluminum, having its own etching solution, had most interesting results. The weakest solution etched gray, as did the others. Grain of the metal began to appear and only slight value differences were evident. This increased with a stronger ratio of powder to water. A straight mixture worked extensively and softly to produce the value and shapes within the area. The characteristics of the metal were responsible for these occurences. Depth is prominent within this area and value so sensitive that they overshadow the results of the other two metals.

At the conclusion of the test pattern plates, it became apparent to me that I needed to see the potentials of the metals fully expanded to include work with imagery of the type that I use. It was due to this that I then prepared three more plates, one of each metal, and executed imagery upon them. Still later, another set of three plates were approached with imagery, but in this instance, the plates were printed in unison in one composition.

The information gathered through the image oriented works gave to me a clear and concise understanding of just how adaptable my work and the three metals might be.

CHAPTER III

SUMMARY AND CONCLUSIONS

After an initial period of unfamiliarity with magnesium and aluminum, each surface accepted the techniques and tools well and resulted in individual characteristics relative to each metal. Desirable results were the rule rather than the exception during the investigation. It was apparent that the metals and their different properties would reveal effects which were diverse.

Magnesium, as a printing surface, became easily adaptable to each technique. The etching process was so rapid in an eight to one water and acid mixture that absolute control was essential. It had been recommended that a mixture of sixteen to one be used to achieve a slower and more easily controlled etch, but the eight to one was a common ratio at most colleges and universities and it was important to use this particular bath to see how the metal would respond in normal circumstances. Through a process of thirty second etches, ranging in total times of one to seven minutes, the magnesium was etched with good control.

Zinc was a metal known for its stability in the print process and held few surprises. It remained stable, and consistently produced desirable results with each different technique.

Aluminum is a soft metal and possessed a unique surface quality unlike the other two metals. When etching in the special acid, a crust would form over the exposed etching area. This was a residue of metal and bubbles from the acid acting on the open area and at first this was thought to be interferring with the acid's action. It was not, for this action continued under the crust. At times this crust grew to heights of one-half inch above the surface plane. The duration of the etch was not unlike that of zinc for the various techniques.

The printing of each plate was a concern. Aluminum was extremely soft and magnesium was so brittle that a break down under hand wiping and press pressure would surely result in wearing away the relief areas. However, each surface on each metal held up very well. Subtle changes were seen on the magnesium after six runs through the press and a more rapid deterioration began after twelve to fifteen runs in the aquatinted areas. Decreasing the pressure slightly gave a longer life to the ability to print significant impressions. Wiping the magnesium was difficult due to the rapid oxidation of the surface. The soft, brittle metal and the greasiness of the ink combined and a thin film was always present. Newsprint could remove it, but this absorbed ink from the etched areas. This plate held up very well through the press runs. Lower relief areas (aquatint, drypoint) did breakdown, but normal editions of ten to fifteen were possible before re-etching was necessary. Zinc, of course, was reliable throughout the printing process and this was expected, but breakdown of specific surfaces is probable with a higher number of impressions.

As a further area of development in the investigation, a test of each metal surface seemed necessary where imagery was utilized in order to observe the harmony of several of the techniques used together in a composition. Three plates, one zinc, one magnesium, and one aluminum, were prepared identically to those before. Tools and techniques used in the primary investigation were used again, as were several variations of the same. Size of the magnesium and zinc plates remained consistent with each other, but the aluminum was a two plate work, somewhat larger lengthwise than the magnesium and zinc plates.

There was little difference in the basic techniques and their results compared to the first phase of investigation. Each metal had a curious visual feeling when many of these techniques were used together. For instance, aluminum was a soft pliable metal and this was readily apparent from the graininess and overall soft textures. They were forceful yet subtle in value differences.

Magnesium was also soft, but etched so differently. Lines were very clear and clean and with the combination of techniques applied in and around the basic line structure, there was a vitality unlike the other plates.

Zinc, being somewhat more hard than aluminum or magnesium, was strong in the visual results of technique combination. Its resultant clear impressions were both desirable and expected.

In addition to the test plates, one edition was completed to emphasize the harmonious printing of one zinc, one magnesium, and one aluminum plate simultaneously on one printing surface. This simultaneous printing of all three plates reaffirmed the idea of harmony in coexistence. Soft aluminum, soft and brittle magnesium, and zinc work extremely well together, revealing possibilities of many variations of combinations.

Each metal became a unique surface during the application of each technique and its printing. They reacted differently to the various techniques based on each metal's inherent properties.

Magnesium was similar to zinc in that the high contrast was very evident after printing. Aquatinted areas were rich and dark. In the cleanly wiped areas of the plate, there was an intense contrast to the aquatinted or mezzotinted areas.

Aluminum revealed a graininess inherent in its metal properties. This was visually exciting. Due to a rapid oxidation and the softness of the metal, a thin film of ink was always present where clean, unetched metal was showing. This film and the grainy look was dominant but not unpleasant.

Zinc was and always will be a stable metal. There were few surprises when working on its surface. It is sturdy and can stand up to a large number of impressions. As with magnesium, the impressions show high contrast between the unetched portions and the etched portions of the surface.

Several of the variations of techniques allowed for a renewed interest in surface qualities. Line was a basic ingredient in all three individual plates. It serves as contour and helps build texture. In combination with the more textural techniques, it alludes to dimension. Each individual plate contained line within the imagery, yet the lines were different in that the result was different visual effectiveness.

Aquatint was used in many ways, but was basically identical on all three surfaces. Some of the values were produced by scraping and burnishing to achieve gradated value areas. Another method of aquatinting was the use of a hand held bag in spreading the powdered rosin. The granules were more varied in size which resulted in a pleasing effect as seen on the second zinc impression. The interplay of white dotted areas and the darker etched areas surrounding them was very effective and created a more varied surface unlike a fine powdered aquatint which produces an evenly tinted surface. These variant techniques were used on all plates following the primary investigation, and added to the richness of the harmonious techniques. Deviation from techniques employed on the primary test plates was necessary and a natural progression towards a harmony of all techniques.

The basic disadvantage of any of the three surfaces was that magnesium proved insufficient for repeated test runs. After twelve to fifteen impressions, the aquatint rapidly began to lose its value. The small amount of drypoint managed to hold up through the same number of press runs, however, had it been alone, on a clean plate instead of under and/or used with various other techniques, it would have deteriorated more rapidly. The number of working proofs would have to be limited in order to produce a sizeable edition. Seen in a total, there were few disadvantages.

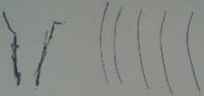
The individual texture of each metal proved visually enlightening in the printed impressions. Unlimited possibilities exist for alterations in metal surfaces used in this investigation. It was a true education to handle and visually experience the two new metals, magnesium and aluminum. In addition to this, a re-evaluation and rediscovery of zinc took place, adding to the number of possibilities of printmaking with intaglio processes. All possibilities have certainly not been explored in association with any of these three surfaces, as each individual involved in printmaking will continue to pursue his or her own ideas. A realm of technical as well as creative possibilities can be extensively pursued.

At the conclusion of the test patterns, I felt a compulsive desire to continue the etching experience on the three metals. Too much information was lacking for opinions to be formed from the initial work. Etching times had been established, printing problems had been found and solved, and the inking process revealed problems for which solutions were found. I began new plates and was free from these problems to concentrate on adapting imagery to the metal plates.

The zinc surface lent itself to all techniques as usual. Most techniques worked well on the magnesium surface. The aluminum plate resulted in impressions of visual subtleties not found in zinc or magnesium. Values were strong, yet their soft transitions from light to dark became dominant throughout the second aluminum plate. The film of oxidation, referred to earlier, was pleasing in its relation to the soft gradations within the etched areas. The surface of the printed image became much more subtle due to the lack of whiteness and its resultant high contrast.

The images taken from this plate were visually strong and extremely rewarding for me. The feeling of confidence and potential that I felt for these metals, aluminum in particular, was achieved through the work with the test patterns. There, the period of unfamiliarity was dealt with purely in respect to technicalities and further complexities such as composition could be put aside.

It is important that I continue to use aluminum in my working processes. My response to its potential and its printed effects is such that it is demanded of me. This demand will add a new dimension to my work and growth is a certainty.



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